

GreenGov Spotlight

Cooling Tower Water Treatment

Twitter handle: US_GSAR8
#watersavings

Cooling Tower Project

The primary objective of this project is to save water through chemical treatment.

Overview of Cooling Tower Water Treatment

Drivers

Location

Opportunities

Results

Next Steps

Cooling Towers

- Cooling towers remove heat through heat transfer
- Water lost through drift and evaporation
- Water lost through blow-down for scale

Video: How a Cooling Tower Works

[http://www.youtube.com/watch?
feature=player_embedded&v=z9-cVGrR9OE](http://www.youtube.com/watch?feature=player_embedded&v=z9-cVGrR9OE)

Project Goals

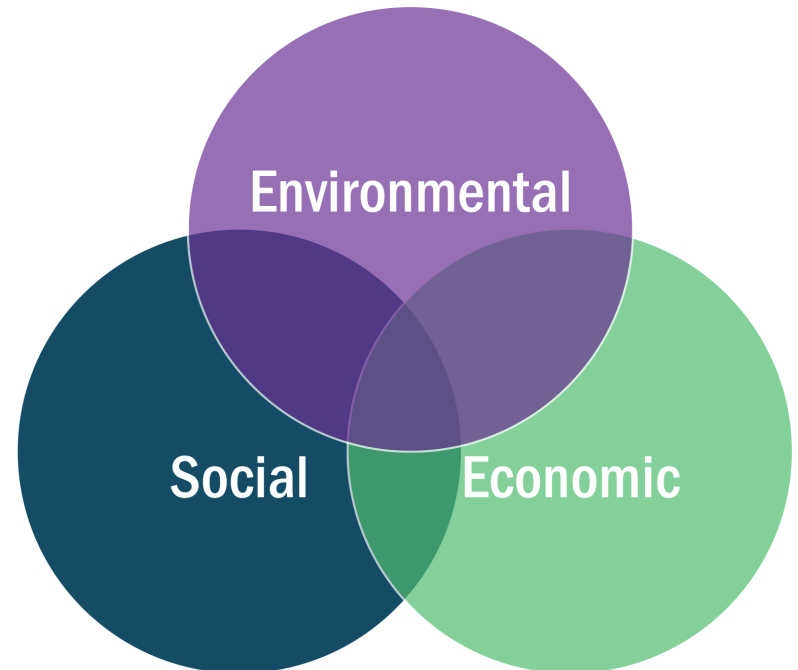
Maintained or improved
mechanical operation

Water reduction

Potential for reduced pollution

Economic payback

Ability to replicate success



GSA Regional Project Team



Doug Baughman, Project Manager

Silas Campbell, Asset Manager

Rob Kirkpatrick, Project Management Lead

Adam Rankin, Building Manager

Andrew Olsen, Energy Manager

Jessica Higgins, Environmental Program Manager

Sue Damour, Regional Administrator

Our Partners

Water Supply

Goal Setting

Measurement and Verification

Reporting



GSA Green Proving Ground Program



Leverages GSA's real estate portfolio to evaluate innovative sustainable building technologies.

Drives innovation in environmental performance and helps leads market transformation.

Includes independent measurement and verification.

Reports are then used to inform decision making within GSA, other federal agencies as well as the real estate industry.

Regional Green Proving Ground Program

Supports national goals while implementing projects to save water and energy.

Utilizes a cross discipline team to determine potential projects and execute them.

Regional GPG projects are funded from solar park and other energy rebates.

Denver Federal Center

A Unique Campus

20 different federal agencies

600 acres of land

4.3 million sf of office, lab and warehouse space

46 buildings ranging in size from sheds to office towers

Over 6,000 federal employees



DFC Water Usage


One acre-foot of water supplies roughly 2.5 households annually.

The Denver Federal Center (DFC) used 325 acre-feet or 106 million gallons of water annually from 2006-2007.

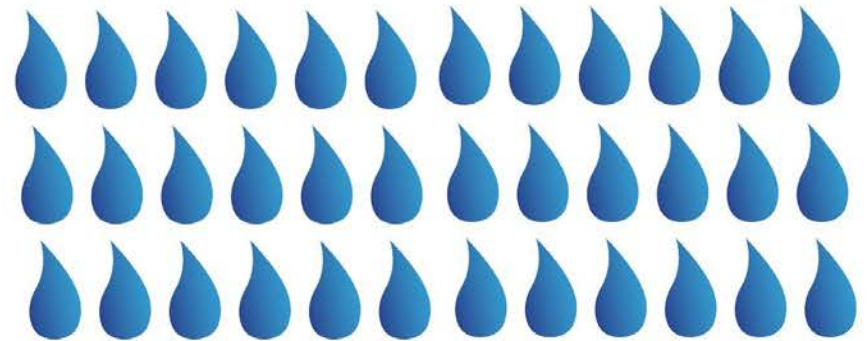
The DFC uses the equivalent water of 811 households annually.

one acre-foot



 equals
9,051 gallons

equals



325,851 gallons

Water Measure Drivers and Challenges

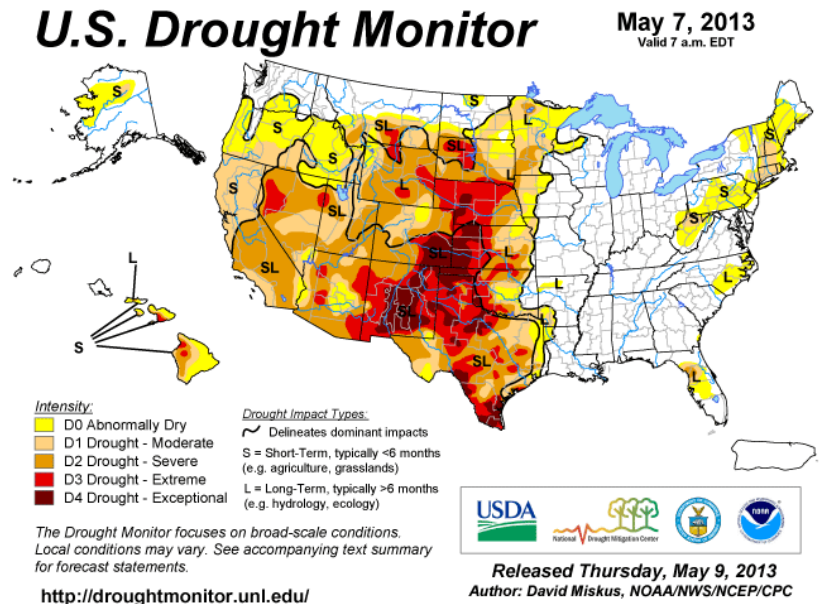
Energy Independence and Security Act of 2007

Executive Order 13514

- In 2012, GSA had achieved 19.27% of its 26% baseline reduction goal set in 2007 for a 26% reduction from the baseline in 2020
- Initial efforts were focused on low hanging fruit (i.e., aerators, low flow fixtures)
- Water costs are low making good paybacks difficult to achieve

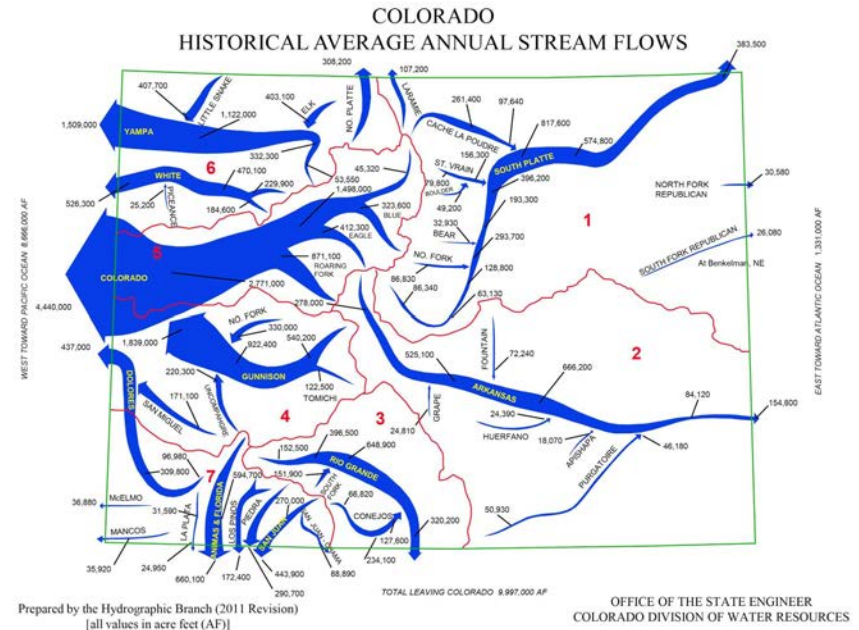
Water Shortage

- The west is currently in severe drought
- Additional water use requires new infrastructure
- Budgets are limited to paying for water and the building of new infrastructure



Relevance to our Location

- State's population is on the eastern side and uses mostly pumped water
- Limited options on storage savings because of Colorado's water laws
- Majority of Colorado water is from western slope and is shipped out of state
- High degree of evaporation
- Water chemistry will be the same across buildings



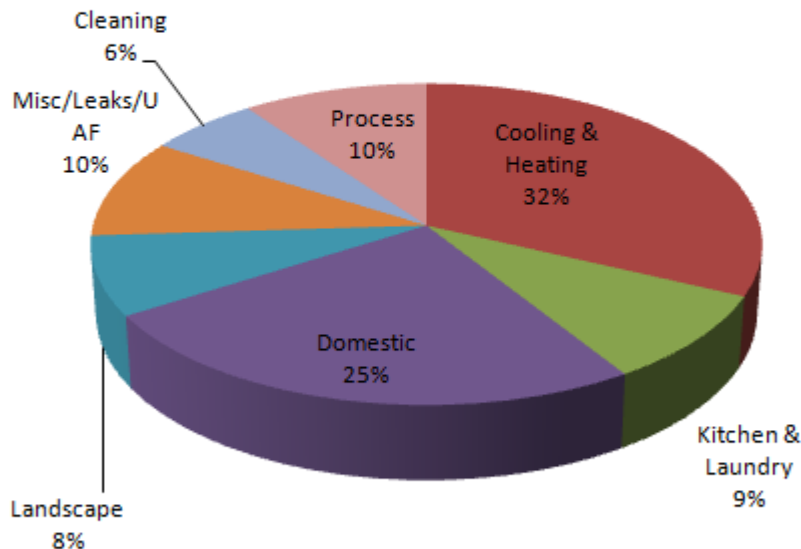
Fact: The average Denver water user uses 86 gallons per day

GSA Region 8 Water Use

GSA region 8 Water Use 2012					
Month	DFC (Gallons)	% of Region Water Use	% of Region SF	Region 8 (Gallons)	
Jan	3,059,555	58.29%	38.30%	5,249,277	
Feb	2,860,855	57.09%	38.30%	5,011,556	
Mar	3,708,278	59.26%	38.30%	6,257,355	
Apr	4,787,799	57.85%	38.30%	8,276,821	
May	6,344,905	59.02%	38.30%	10,750,616	
Jun	13,596,498	70.51%	38.30%	19,282,128	
Jul	18,306,646	75.89%	38.30%	24,121,678	
Aug	15,649,000	73.44%	38.30%	21,309,414	
Sep	6,868,450	65.33%	38.30%	10,514,144	
Oct	6,064,435	69.78%	38.30%	8,690,426	
Nov	3,807,275	64.67%	38.30%	5,887,251	
Dec	1,304,330	40.78%	38.30%	3,198,814	
Totals	86,358,026	67.18%	38.30%	128,549,480	

Building Water Use

**Commercial Water Use In
Denver, 1991**



Source: deMonsabert, Sharon and liner, Brian L. "Watergy: a Water and Energy Conservation Model for Federal

- Largest water users on DFC besides irrigation
- Commonly the largest water consumption in commercial buildings
- Minimal impact to tenants with large results

Overall Strategy

- Address largest water users on DFC
- Improve irrigation water performance
 - Xeriscaping
 - Smart irrigation controls
- Improve cooling tower water performance

Questions?

Potential Opportunities

Address high water consuming processes

Minimize tenant impact

Maximize water savings

Bleed Rates

Cycles Vs. Waste Comparison

1000 Ton Tower, Running 24/7 for 12 Months

Cycles	Evaporation Gals	Bleed-Off Gals	% Wastewater
3	15,768,000	7,884,000	33%
4	15,768,000	5,256,000	25%
5	15,768,000	3,942,000	20%
10	15,768,000	1,752,000	10%
30	15,768,000	543,724	3.33%
50	15,768,000	321,796	2%

Cooling Tower Water Treatment

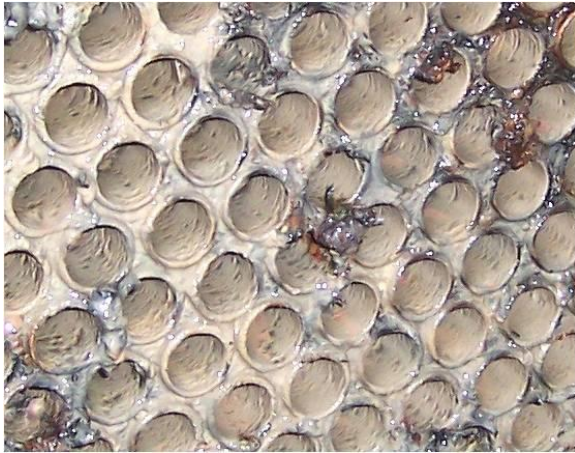
Scale Prevention

Corrosion Prevention

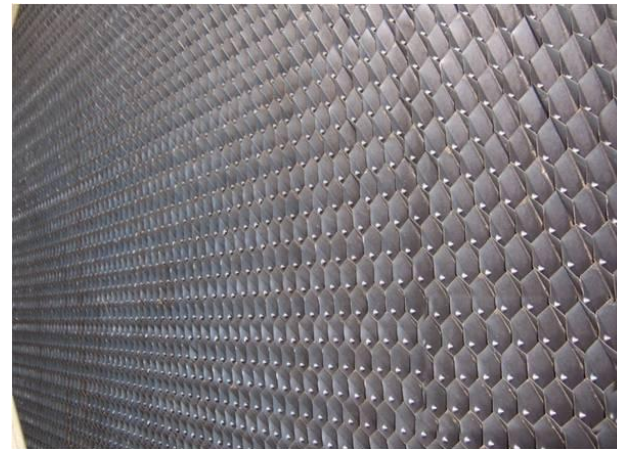
Biological Growth Prevention

Cooling Tower Performance

Scaled Cooling System



Clean Cooling System



Measurement and Verification

- Studies and results of testing to learn from findings and evaluate further implementation.
- Installed meters on these towers as well as worked with Denver Water for preliminary results
- Taking the preliminary results further and doing a complete study with The National Renewable Energy Lab (NREL)

GSA Test Project

Three Technologies

Improved Chemical
Water Softening System
Water Cavitation

Project Costs

Ongoing Maintenance

- Chemicals – scale inhibition, biocides
- Regularly scheduled cleaning
- Monthly reporting

Equipment installation

- Controls
- Tower cleaning
- Side-stream filtration
- Potential tower sweepers
- Metering

Improved Chemical

- Higher cycle of concentration chemical with limited blow-down
- System uses
 - Sweeper jets in tower
 - Glass media side filter
- New controller



Improved Chemical

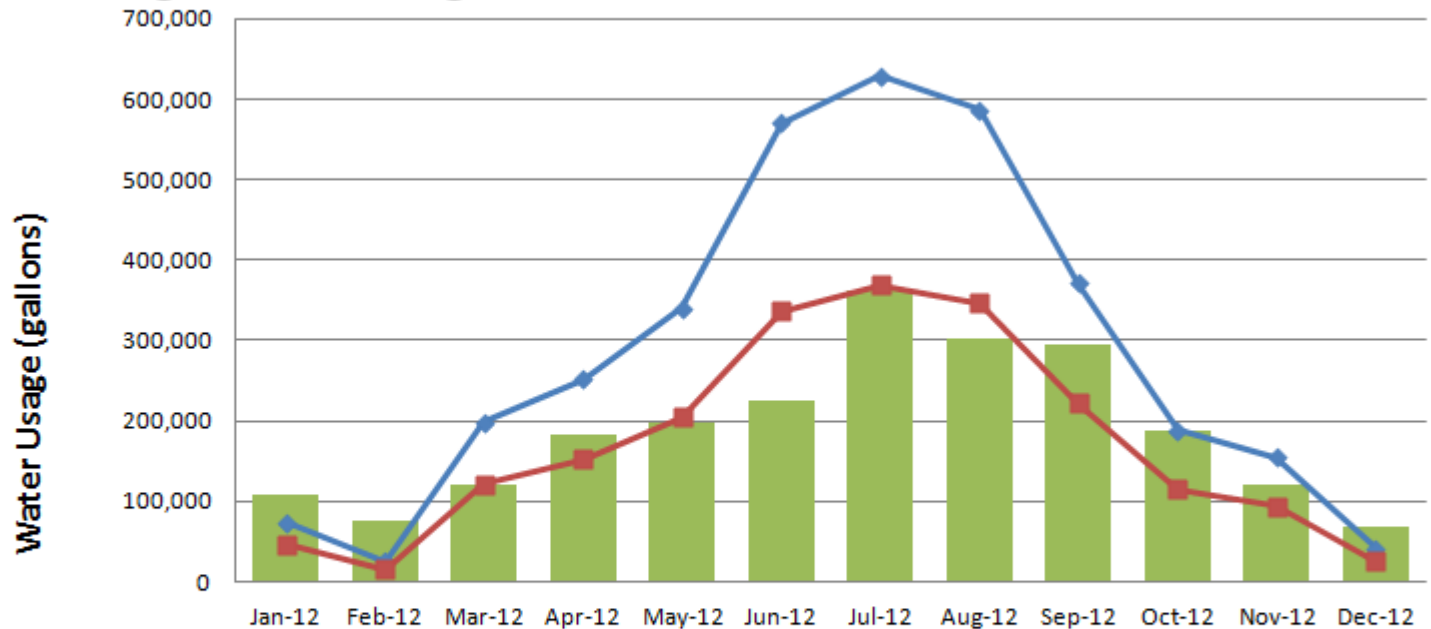
- Reduced water use requires reduced chemical need
- Automated controller manages chemical
- 1995 EPA report on impact of product on pollution at Norfolk Naval Base – Safe for Discharge



Measuring Success

(Improved Chemical)

Building 67 Cooling Tower Water Performance



	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Actual Usage Manual Read (Gal)	107,000	76,200	121,800	182,100	197,100	225,900	361,300	301,600	295,300	187,700	120,400	68,500
Calculated Monthly Water Baseline (Gal)	74,560	25,670	198,922	251,376	340,661	570,124	628,986	586,891	371,441	188,916	154,450	41,880
Calculated Water Use (Gal)	46,633	16,104	121,436	152,437	204,629	335,903	369,233	345,858	222,560	115,016	93,573	25,348

Measuring Success

(Improved Chemical)

Payback

- 1,188,976 gallons saved in 2012
- \$6,515.59 in annual utility cost savings
- Simple payback under 10 years
- Reduced maintenance



Water Softening System

- Pre-conditioning system removes scale-forming ions from tower make-up.
- Allows for zero blow-down with the exception of less than 1% water in regeneration of the system.
- Uses silica concentration to prevent scale, limit corrosion and prevent biological/pathogen growth.
- Controller measuring system and controlling.



Water Softening System

Sidestream Filtration

Brine Tanks

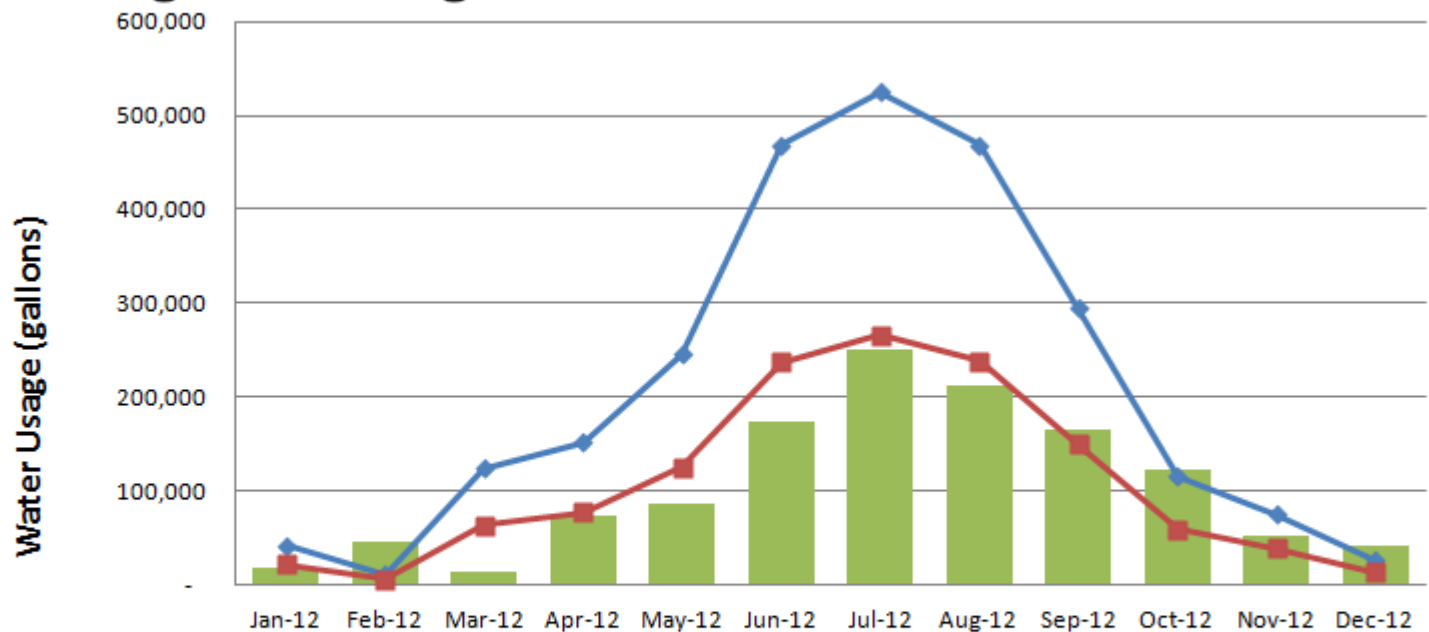
System Controller



Measuring Success

(Water Softening System)

Building 25 Cooling Tower Water Performance



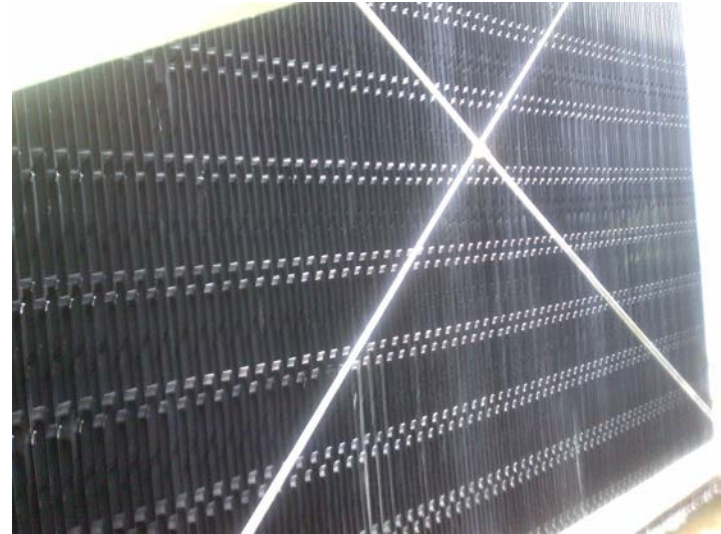
	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Actual Usage Manual Read (Gal)	18,800	45,900	13,100	74,100	85,900	173,000	250,300	212,700	165,200	121,900	51,900	41,100
Calculated Monthly Water Baseline (Gal)	42,100	11,343	124,349	151,574	245,883	468,485	525,124	468,668	294,489	115,634	75,436	26,408
Calculated Water Use (Gal)	21,526	5,798	63,450	77,305	125,088	237,699	266,366	237,818	149,724	59,020	38,575	13,509

Measuring Success

(Water Softening System)

Payback

- 1,295,594 gallons saved in 2012
- \$7,099.85 in annual utility cost savings
- Simple payback under 10 years
- Reduced maintenance



Water Cavitation

- Sidestream pulls water from tower and opposing pressure forces cause small bubbles and cavities that breakdown microorganism and debris.
- Debris is backwashed and removed to the filter.
- Cleaner tower increases efficiency through improved heat transfer.

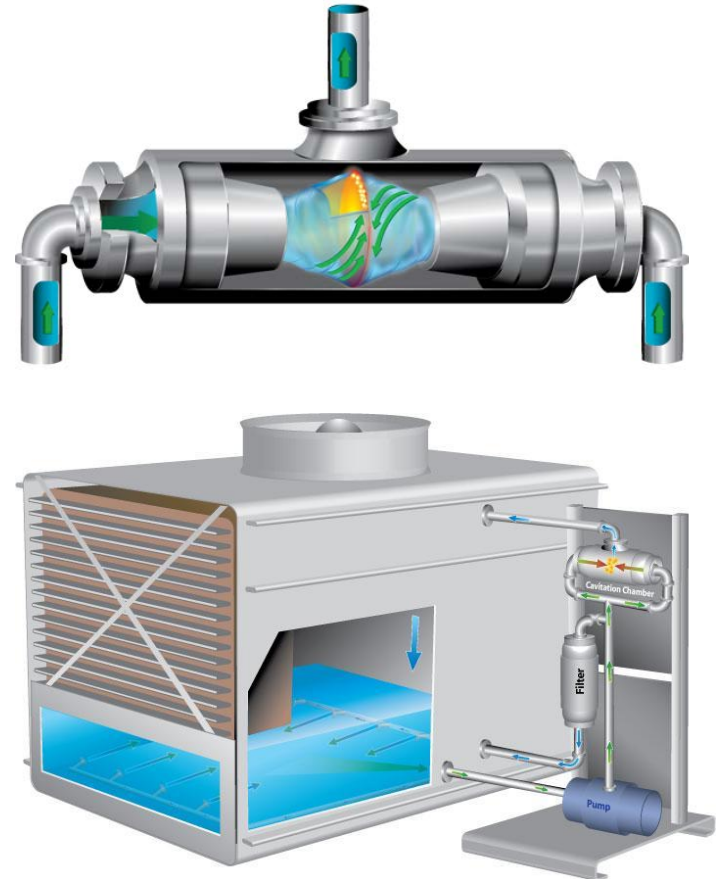


Image 1: vrtxtech.com/cavitation-basics/

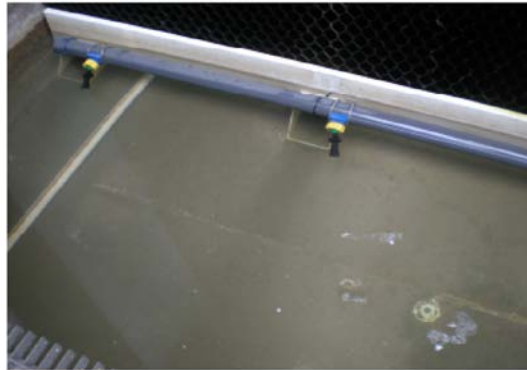
Image 2: <http://vrtxtech.com/solution/>

Water Cavitation

500 ton tower with two 250 ton cells

Control skid

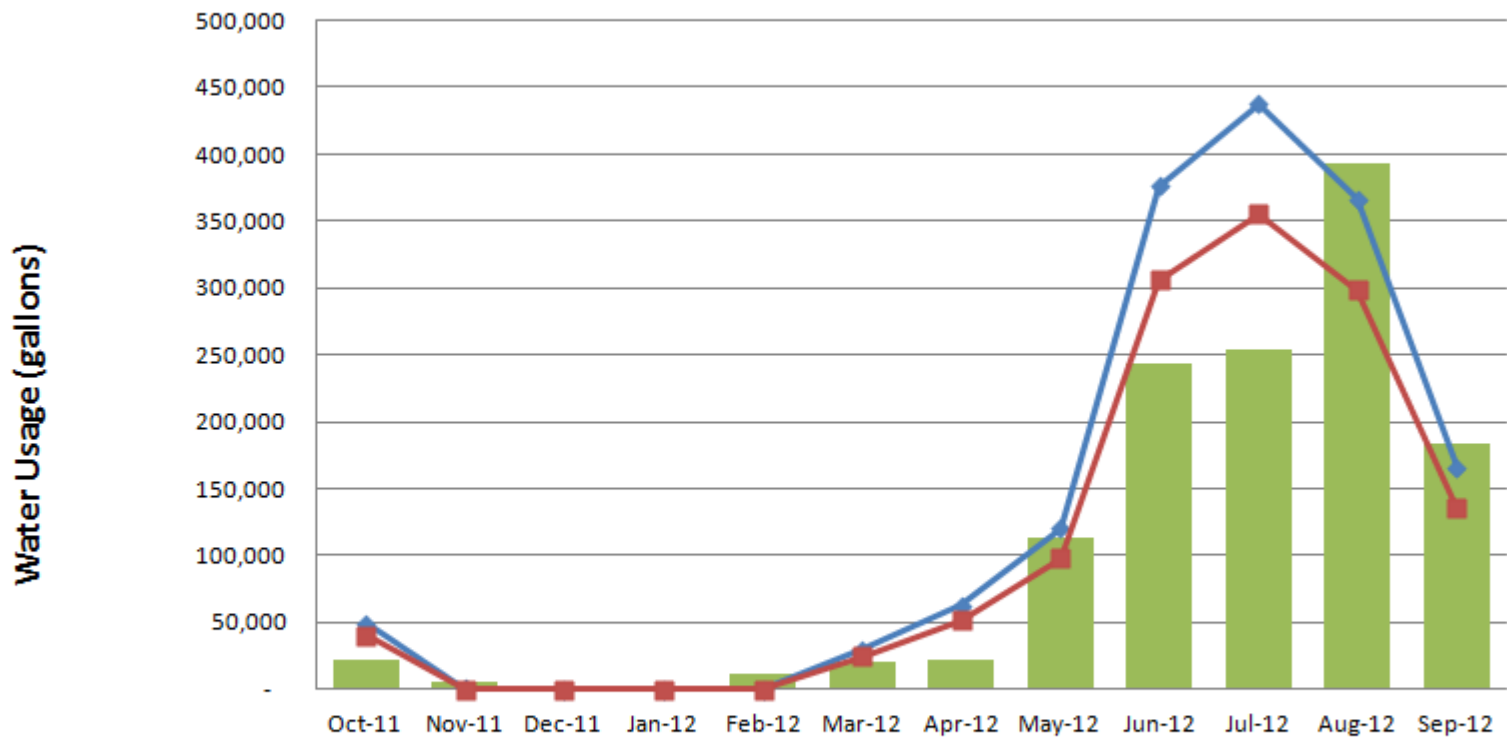
Sweeper jets in the cooling tower



Measuring Success

(Water Cavitation)

Building 95 Cooling Tower Water Performance



	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
Actual Usage Manual Read (Gal)	22,459	5,284	660		11,120	19,980	22,444	112,697	243,784	254,172	393,800	183,700
Calculated Monthly Water Baseline (Gal)	49,411	270	0	0	0	30,144	62,989	120,648	376,361	437,261	366,511	165,918
Calculated Water Use (Gal)	40,203	221	0	0	0	24,536	51,248	98,138	306,077	355,609	298,076	134,957

Measuring Success

(Water Cavitation)

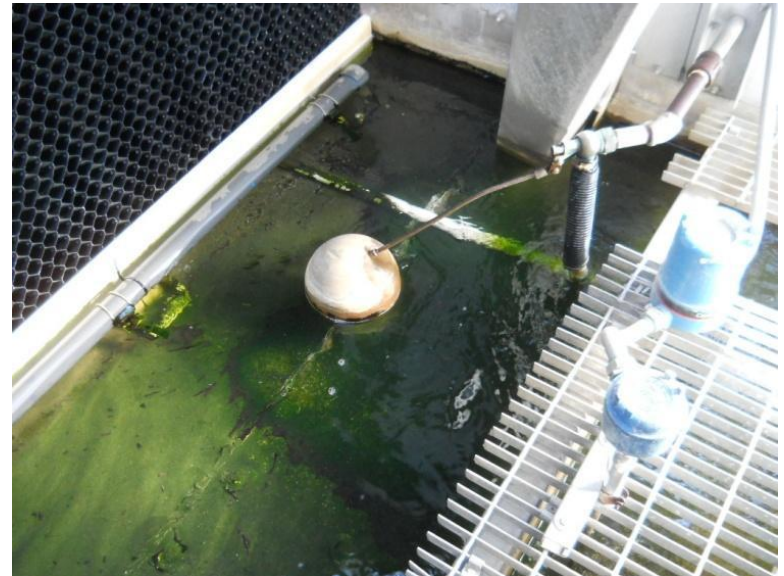
Payback

- 318,135 gallons saved in FY 2012
- \$1,743.38 in annual cost savings
- 20+ year simple payback
- Additional maintenance – algae growth problem
- Increased cleaning and chemical need from treatment

Lessons Learned

Failed Test

- Ionizer used to treat algae blooms was initially set too low
- Energy use increased due to motor constantly running
- Water savings was minimal and additional cleaning was significant



Lessons Learned

- Include O&M staff early
- Include protection of equipment within contract
- Test water chemistry
- Partner with local water company for potential rebates

Achievements

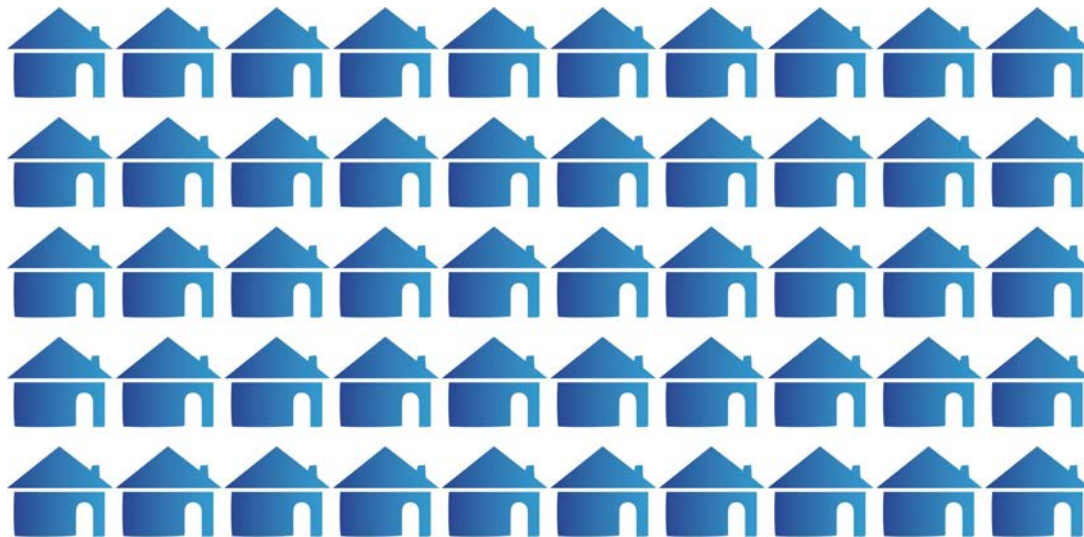
In 2012, GSA reduced water use nationally by 19.2% from a 2007 baseline per SF.

GSA needs to reduce from baseline by an additional 6.8% per SF from 2007 baseline by 2020.

DFC Buildings 25 and 67 dropped building water use over 15% in a single year and saved over 1 million gallons each by using new technologies.

Expanding Impact

Potential for an estimated reduction of 20.29 acre-feet of water annually if replicated campus wide. This water savings equates to enough water to supply an additional 50 households annually.



Next Steps

- Replicate project in four GSA buildings in 2013 with existing technologies (based on preliminary results).
- Complete study with NREL to better share results.
- Address cooling towers through time regionally and move success nationally.
- Share our success both within government and private sector to transform the industry.
- Look at additional technologies that may be helpful and try one new system in 2013.

Replicating Our Success

First Steps

- Address water in cooling towers with your facilities staff or landlords
- Install make-up and blow-down meters on cooling towers this summer to start a baseline
- Perform an analysis of your current water use and potential savings





National GPG Program Website

[HTTP://WWW. GSA.GOV/GPG](http://www.gsa.gov/gpg)

Contact Information

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Questions?